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Determinants of public investment for port authorities using port-level data: An analysis of the Spanish port system

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Abstract

This study analyses the economic and political determinants of Spanish port authorities' public investment from 2000 to 2016 using port-level data. We distinguish two types of investment: (i) infrastructure and capacity; (ii) logistics and intermodal transport. We estimate the empirical specification considering dynamic effects and endogeneity. Unlike previous empirical studies in which aggregate port investment was considered, our results show that both economic criteria and political factors matter in the Spanish port investment allocation. We also find that the relevance of the political factors differs by the type of port investment. In this sense, we show that the coincidence between the incumbent political party in the central and local governments influences the port investment related to infrastructure and capacity, whereas the coincidence between the incumbent political party in the central and regional governments affects logistics and intermodal transport investment.

Keywords: port investment; political economy; Spanish ports; efficiency.

1. Introduction

One of the main aims of transport policies in most countries is to allocate infrastructure investment across regions. According to the political economy literature, there is a trade-off between economic efficiency and political preferences for infrastructure investment on a regional and local basis (Castells and Solé-Ollé, 2005; Cadot et al., 2006;).

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Castells and Solé-Ollé (2005) suggest that efficiency criteria play only a limited role in the geographical distribution of government infrastructure investment at a regional level in Spain. In fact, the parliamentary support provided by nationalist political parties to the governing party in Spain, the number of votes required in the region to secure a representative in parliament, or the alignment of the same political party in both the central and regional governments are political factors correlated with a higher level of government infrastructure investment among regions. Cadot et al. (2006) study the determinants of investment in infrastructure in French regions. The influence of large companies in specific regions or the difference in votes between the two main political parties are relevant factors, even more important than the productivity of the investment for the region. Kemmerling and Stephan (2002) analyze the allocation of public infrastructure investment for large German cities. They find that the coincidence of the same political party between state and local government is decisive in explaining local public investment across cities.

Focusing on sectoral studies, Bel and Fageda (2009), and Bilotkach (2010) examine the determinants of airport investments in Spain and the US, respectively. In the case of Spain, Bel and Fageda (2009) find that airport investment is higher in regions where support for the party in the central government is greater. Moreover, more public resources are invested in regions where there is a coincidence between the incumbent party in the central government and the incumbent party in the regional government. In the US, airports located in districts with the larger Obama-McCain vote differential in the November 2008 election received larger American Recovery and Reconstruction Act (ARRA) grants. Other political factors, such as the senators' party affiliation and representatives' membership in the House Committee on Transportation and Infrastructure, also explain the allocation of the ARRA grants to the airports. Regarding ports, Castillo-Manzano and Fageda (2014) estimate the determinants of public investments made by the central government to the regions. They find that efficiency factors play a more relevant role in the regional allocation of port investment than in other transport infrastructures. Factors such as the use of the infrastructure, measured as the ratio between port traffic and capital stock ratio, or the specialization in the containerized general cargo traffic influence investment allocation. Concerning political variables, the coincidence of the same political party in both the central and the regional governments has some influence on the amount of public resources for port investment.

Unlike other European port models, the Spanish port model has been traditionally centralised. The State-owned Spanish Port System includes 46 ports of general interest, managed by 28 Port Authorities. Since 1992, the government agency *Puertos del Estado*, under the Ministry of Public Works, has been responsible for coordinating, controlling efficiency, and implementing the government's port policy. Following a port landlord governance model, port authorities lease port infrastructure to private port operators, retaining ownership of the land. Private port operators carry out different port operations through concession contracts of limited duration and are responsible for port superstructure investments (Cano-Leiva et al., 2023). In other countries such as Germany, Belgium, or The Netherlands, ports present a more decentralised system, managed by companies partially owned by local and regional governments. In 1997, a legal reform allowed including representatives of both regional and local governments in the board of directors of Spanish port authorities. Then, a new framework was developed based on a cooperative management model between the central administration, the regional government, and other local entities. The analysis of port investment in Spain is relevant considering that it was almost double as in Italy, more than three times as in Germany and six times as in France between 2000 and 2010 (Albalate et al., 2015). From 2000 to 2016, the aggregate port investment surpassed 10,600 million euros. These investments have allowed enlarging the space dedicated to port operations, expanding capacity, building new infrastructure and superstructure, and endowing the Spanish port system with modern facilities and better connections with other transport nodes. In fact, recent research has shown that strategic interdependence in capacity decisions has occurred in the Spanish port system (Hidalgo-Gallego et al., 2021). In this sense, Tovar and Wall (2022) point out that the increase in public infrastructure investment in Spain has been linked to the port authorities' competitive strategy, mainly based on investment policy. Focusing on containerized cargo, Esparza et al. (2017) demonstrate that the Spanish port system appears to be oversized and subsidized in relation to container traffic. Their results show aggregate port capacity with an idle rate of 64 percent.

This paper presents new evidence by analysing the determinants of Spanish public investment allocation for port authorities, considering two different types of investment: (i) infrastructure and capacity; (ii) logistics and intermodal transport. Our empirical specification is based on the methodology of the Castillo-Manzano and Fageda's previous study, existing two main differences among them. First, the data sources differ. While their study uses data at the provincial level (NUTS-3) from data that the BBVA-IVIE Foundation publishes periodically, our research proposal uses more disaggregated data at the port authority level from Puertos del Estado and the port authorities' annual

reports. Additionally, these reports provide statistical information on port investment distinguished by different categories. Second, we assess a more recent period from 2000 until 2016, given that Castillo-Manzano and Fageda's research covers the period 1985-2002.

2. Model

Our econometric model is based on the empirical specification of Castillo-Manzano and Fageda (2014). It is as follows:

$$inv_{jit} = \alpha + \beta_1 inv_{jit-1} + \beta_2 k_{it-1} + \beta_3 \left(\frac{q}{k}\right)_{it-2} + \beta_4 y_{it-1} + \beta_5 c_{it-1} + \beta_6 r_{it-1} + \gamma \mathbf{z}_{it} + \varepsilon_{it} \quad (1)$$

The dependent variable (inv_{jit}) is the amount of investment in infrastructure in the category j for the port authority i during year t. In this study, two dependent variables have been considered: investment in port infrastructure and capacity, and investment in logistic activities and intermodality. These investment categories were chosen for several reasons. Firstly, due to its important weight in global investment. In 2016, they together represented more than 50 percent of the investments made. Secondly, these types of investments have significant economic effects on the hinterland where port authorities are located. On one hand, investment in port capacity has traditionally been considered a strategy to attract new traffic and implement preventive measures against interport competition (Luo et al., 2012). Furthermore, increasing port activities fosters local and regional employment and economic growth (Bottasso et al., 2014; Park and Seo, 2016; Shan et al., 2014; Brooks et al., 2021; Hidalgo-Gallego and Núñez-Sánchez, 2023). In a similar vein, Song and van Geenhuizen (2014) and Song and Mi (2016) find a positive impact of port investment on regional development. Finally, Wu et al. (2016) demonstrate that port investment enhances local government performance. On the other hand, investment in logistics activities and intermodality aims to enhance port connections with other modes of transport (such as road and rail) and streamline cargo handling processes. In this context, several authors argue that hinterland access is a pivotal factor influencing a port's competitiveness (Notteboom, 1997; Fleming and Baird, 1999; Zhang, 2009). Moreover, the enhancement of intermodal connection infrastructure is crucial to facilitate the distribution of positive impacts from ports to their hinterlands.

The dependent variables and explanatory variables (Table 1) include port-related characteristics but also political factors on a provincial and local basis. Data comes from two sources. Port-related data was obtained by different reports from Puertos del Estado, whereas political variables were gathered from the Ministry of Domestic Affairs website. Following Castillo-Manzano and Fageda (2014), within the port characteristics that could affect investment allocation, we have considered (1) the investment of the port authority in the previous period to collect the multi-annual nature of these projects (inv_{jit-1}); (2) the port authorities' capital stock infrastructure (k_{it-1}) to test if investments are allocated following equity criteria, this means that less capitalized authorities should receive more resources; (3) the ratio of port traffic and capital stock ($(q/k)_{it-2}$) as an indicator of efficiency; (4) GDP per capita (y_{it-1}) to proxy the economic wealth of the province where the port authority is located; (5) the percentage of container traffic (c_{it-1}) to explore how container specialization affects the amount of investment received by the port authorities; and (6) the percentage of added value in manufacturing and construction activities (r_{it-1}) to collect the effect of the existence of lobbying forces with interest in port investments.

Regarding the second group of variables considered to measure the effect of political factors on investment allocation, we include (1) the percentage of votes of the incumbent party in the central government in the elections across regions (VOTES) to approximate the political capital of regions and the potential for greater investment; (2) the coincidence of the same political party in the regional and national government (D^{RC}) to collect the political bias in investment distribution based on government affiliations; (3) in a similar way than the previous, the coincidence of the same political party in the local and national governments (D^{LC}) is also included; (4) the strength of the nationalist parties (D^{SRP}) to capture their influence in central government decisions; (5) swing voter (SWING) measures the difference in the percentage of votes between the incumbent party and the second-largest party in national elections; and finally (6) the elect product variable (VOTES/SEATS) is included to examine if the incumbent party invests more in regions with higher electoral productivity.

Table 1. Data definition

Variable		Definition
Dependent variable		
inv_{jit}		Amount of investment in infrastructure in the category *j* for the port authority *i* during year *t*
Explanatory variables		
inv_{jit-1}	LAG_INV	Amount of investment in infrastructure in the category j for the port authority *i* lagged one year
k_{it-1}	STOCK CAPITAL	Capital stock in infrastructures for the port authority *i* during year *t*
$\left(\frac{q}{k}\right)_{it-2}$	TRAFFIC/CAPITAL	Ratio of port traffic and capital stock for the port authority *i* during year *t-2*
y_{it-1}	GDP PER CAPITA	Gross domestic product per capita of the province in which the port authority is located during year *t-2*
c_{it-1}	CONTAINERS	Percentage of containerised traffic for the port authority *i* during year *t-1*
r_{it-1}	IND ACT	Percentage of added value in manufacturing and construction activities of the province in which the port authority *i* is located
$\boldsymbol{z}_{it}$		Vector of variables related to political factors
$VOTES$	VOTES INCUMB	Percentage of votes of the incumbent party in the central government in the elections to the central parliament across regions
D^{RC}	COINC CENT/REG	Coincidence of the same political party both in the central and regional government in the province where the port authority is located (dummy variable)
D^{LC}	COINC CENT/LOC	Coincidence of the same political party both in the central and local government in the largest town or city in which the port authority is located (dummy variable)
D^{SRP}	INF NATION PART	Influence of nationalist parties which are in power in their corresponding regional government during the periods where the party in the central government does not have enough support in order to approve political reform (dummy variable)
$SWING$	SWING VOTER	Difference in the percentage of votes in the national elections between the incumbent party in the central government and the political party with the second largest number of votes at the national level
$VOTES/SEATS$	ELECT PRODUCT	Percentage of votes in the province in which port authority is located in relation to the percentage of seats in the province over total national seats

Three different econometric techniques have been considered as a robustness check: first, a pooled model using the Prais-Winsten regression with an AR-1 disturbance; second, a G2LS random effects instrumental variables regression where we consider traffic as an endogenous variable; and, third, a fixed-effects model with an AR-1 disturbance. The third and fourth lags of the ratio (q/k) and geographical variables of longitude and latitude are considered instruments in the instrumental variables specification.

3. Results

3.1. Descriptive analysis

Figure 1(a) displays trends in investment and traffic in the Spanish port system from 2000 to 2016. On the one hand, it shows different trends for traffic and investment. This fact suggests that other factors unrelated to port services' demand may affect port managers' investment decisions. On the other hand, an investment process in the Spanish state-owned ports occurs until 2008. Figure 1(b) shows the distribution of investment by categories for each port authority. More than 50 per cent of investment is allocated to expanding pot capacity and infrastructure in most of them. In contrast, logistics and intermodal transport represent less than 7 per cent on average in the Spanish port system.

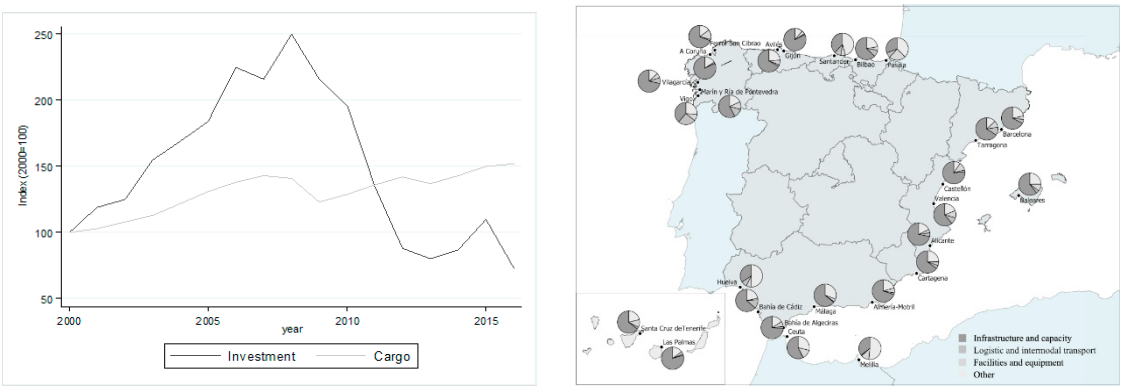

Fig. 1. (a) Trends in port authorities' investment and traffic; (b) Distribution of port authorities' investment by categories.

3.2. Econometric results

We proceed to estimate the empirical model disaggregating the two different investment categories. Table 2 shows the estimates of the capacity and port infrastructure investment model. We find that investment during the previous period (inv_{jit-1}), the stock of capital (k_{it-1}), the proxy of port efficiency ($(q/k)_{it-2}$), and the specialization in containerized traffic (c_{it-1}) in most cases are positive and statistically significant when panel corrected standard errors or instrumental variables are used. We also find that the variable related to the coincidence between the incumbent political party in the central and local governments (D^{LC}) is positive and significant. However, analyzing the fixed-effects model, we find that several port-related variables lose statistical significance, except inv_{jit-1}, but political factors such as the percentage of votes for the incumbent party in central government in the national elections (*VOTES*), the electoral productivity (*VOTES/SEATS*), or the swing voter hypothesis (*SWING*) achieve statistical significance. These variables present positive coefficients except for the *SWING* variable, which shows a negative coefficient.

Table 2. Determinants of port investment related to infrastructure and capacity.

	Panel-corrected standard errors with AR-1 disturbance				G2SLS random effects-IV			Fixed effects model with AR-1 disturbance				
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(1)	(2)	(3)	(4)	(5)
inv_{jit-1}	0.491***	0.521***	0.650***	0.650***	0.281***	0.253***	0.321***	0.404***	-	0.457***	0.398***	0.394***
	(7.35)	(7.85)	(11.92)	-11.86	(2.78)	(2.67)	(3.14)	(8.3)		(9.62)	(8.37)	(8.23)
k_{it-1}	0.491***	0.471***	-	-	0.518***	0.533***	0.643***	-0.399	0.322	-0.233	-	-
	(3.83)	(3.72)			(11.65)	(12.17)	(16.48)	(-1.14)	(0.94)	(-0.67)		
$\left(\frac{q}{k}\right)_{it-2}$	0.317***	0.280***	0.377***	0.377***	0.469***	0.466***	-	0.162	0.31	0.164	0.266	0.3
	(4.1)	(3.57)	(5.14)	(5.13)	(4.96)	(4.97)		(0.66)	(1.47)	(0.68)	(1.26)	(1.39)
y_{it-1}	-0.156	-0.26	-	0.0331	-0.167	-0.268	-	1.116	1.651	-	-	0.999
	(-0.30)	(-0.96)		(0.07)	(-0.32)	(-0.78)		(0.87)	(1.31)			(0.79)
c_{it-1}	0.0131	0.0118	0.0507***	0.0506***	0.0121	0.0111	0.0528***	-0.0322	-0.0822*	-0.0121	-0.034	-0.0379
	(0.57)	(0.52)	(3.12)	(3.08)	(0.64)	(0.59)	(3.01)	(-0.80)	(-1.92)	(-0.31)	(-0.86)	(-0.95)
r_{it-1}	-0.487	-0.685	-0.415	-0.434	-0.433	-0.625	-0.286	-1.073	-0.409	1.452	1.345	0.401
	(-0.68)	(-1.08)	(-0.66)	(-0.61)	(-0.49)	(-0.77)	(-0.34)	(-0.16)	(-0.06)	(0.23)	(0.2)	(0.06)
$VOTES$	0.281	-	0.102	0.116	0.258	-	0.114	1.049*	1.991***	-	1.083*	1.090*
	(0.72)		(0.37)	(0.30)	-0.65		-0.33	(1.74)	(3.14)		(1.8)	(1.8)
D^{RC}	-0.038	-	-0.035	-0.0344	-0.0393	-	-0.0397	-0.101	-0.0993	-	-0.0941	-0.103
	(-0.30)		(-0.28)	(-0.28)	(-0.30)		(-0.29)	(-0.71)	(-0.67)		(-0.67)	(-0.73)
D^{LC}	0.227**	-	0.214**	0.215**	0.219**	-	0.215*	0.357***	0.503***	-	0.351***	0.352***
	(2.13)		(2.26)	(2.26)	-2.04		-1.95	(2.97)	(4.02)		(2.92)	(2.93)
D^{SRP}	0.118	-	0.207	0.204	0.114	-	0.227	-0.156	-0.411	-	-0.155	-0.161
	-0.77		-1.32	-1.28	-0.55		-1.11	(-0.62)	(-1.54)		(-0.62)	(-0.64)
SWING	-0.00732	-	-0.00585	-0.00599	-0.00696	-	-0.00604	-0.0153*	-0.02***	-	-0.0164*	-0.0157*

	(-1.23)		(-1.18)	(-1.05)	(-0.99)		(-0.88)	(-1.73)	(-2.92)		(-1.87)	(-1.78)
VOTES/SEATS	-0.0463	-	-0.0537	-0.0519	-0.0403	-	-0.0396	2.042	2.756**	-	1.756	1.759
	(-0.94)		(-1.30)	(-0.96)	(-0.62)		(-0.65)	(1.55)	(1.98)		(1.35)	(1.36)
CONSTANT	-	-	5.989***	5.935***	-1.011	-0.758	5.943***	36.89**	37.22**	12.29*	29.02**	26.72*
			-4.94	-4.86	(-0.53)	(-0.43)	-5.7	(2.19)	(2.15)	(1.82)	(2.08)	(1.87)
N	413	413	413	413	413	413	413	413	440	413	413	413

Note: t statistics in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01

Table 3 presents the results of the intermodal transport investment model. In this case, we find results similar to those of the previous, with some exceptions. For instance, the GDP per capita (y_{it-1}) is statistically significant when panel-corrected standard errors or instrumental variables are used. However, the investment during the previous period (inv_{jit-1}) is no longer significant in the instrumental variables specification. Regarding political factors, the variable related to the coincidence between the incumbent political party in the central and local governments (D^{LC}) loses its statistical significance to the detriment of the variable related to the coincidence between the incumbent political party in the central and regional governments (D^{RC}). This result can be partially explained by the fact that investment in capacity could positively affect the economic performance of the city where the port is located. Therefore, local governments could be highly interested in this kind of investment. However, regional governments may be more interested in extending these positive impacts beyond city boundaries, for which investment in intermodality is crucial. We also find that variables *VOTES/SEATS* and *SWING* continue to be statistically significant.

Table 3. Determinants of port investment related to logistics and intermodal transport.

	Panel-corrected standard errors with AR-1 disturbance				G2SLS random effects-IV			Fixed effects model with AR-1 disturbance				
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(1)	(2)	(3)	(4)	(5)
inv_{jit-1}	0.315***	0.352***	0.376***	0.352***	-0.572	-0.0796	-0.214	0.303***	-	0.322***	0.310***	0.305***
	(4.13)	(4.56)	(5.04)	(4.68)	(-1.01)	(-0.15)	(-0.40)	(6.01)		(6.47)	(6.18)	(6.07)
k_{it-1}	1.36***	1.230**	-	-	0.396***	0.437***	0.440***	1.323	1.536	2.131	-	-
	-2.85	-2.35			(8.53)	(9.67)	(9.75)	(0.66)	(0.81)	(1.08)		
$\left(\frac{q}{k}\right)_{it-2}$	-0.381	0.0632	0.131	0.0997	1.240***	1.100**	-	0.843	0.106	1.014	0.0824	0.368
	(-0.61)	(0.1)	(0.24)	(0.18)	(2.66)	(2.37)		(0.59)	(0.09)	(0.73)	(0.07)	(0.3)
y_{it-1}	7.205**	2.347	-	7.59**	6.205**	1.829	-	7.372	8.05	-	-	7.836
	(2.4)	(0.99)		(2.5)	(2.07)	(0.92)		(0.99)	(1.16)			(1.06)
c_{it-1}	-0.0247	-0.0256	0.157	0.131	-0.0294	-0.0284	0.142	-0.191	-0.00634	-0.201	-0.15	-0.176
	(-0.22)	(-0.21)	-1.59	-1.35	(-0.27)	(-0.26)	-1.49	(-0.82)	(-0.03)	(-0.90)	(-0.65)	(-0.76)
r_{it-1}	-4.721	1.594	-0.236	-4.416	-3.832	1.614	0.282	45.29	60.76	75.50**	46.21	39.64
	(-1.14)	-0.45	(-0.06)	(-1.09)	(-0.77)	(0.35)	-0.06	(1.14)	(1.64)	(2.02)	(1.21)	(1.02)
VOTES	2.18	-	-0.96	2.094	2.162	-	-0.588	3.102	3.245	-	3.057	3.042
	(0.87)		(-0.45)	(0.85)	(0.96)		(-0.31)	(0.9)	(0.93)		(0.89)	(0.88)
D^{RC}	2.49***	-	2.19***	2.3***	2.29***	-	2.031***	1.973**	2.385***	-	2.029**	1.972**
	(3.14)		(2.72)	(2.96)	(3)		(2.63)	(2.38)	(2.92)		(2.46)	(2.38)
D^{LC}	-0.15	-	-0.0531	-0.0444	-0.0993	-	-0.011	0.69	0.719	-	0.712	0.713
	(-0.22)		(-0.08)	(-0.07)	(-0.16)		(-0.02)	(0.99)	(1.04)		(1.03)	(1.03)
D^{SRP}	0.532	-	1.775	1.034	0.766	-	1.906*	0.534	-0.35	-	0.59	0.544
	(0.33)		(1.15)	(0.65)	(0.65)		(1.66)	(0.36)	(-0.24)		(0.4)	(0.37)
SWING	-0.07**	-	-0.04	-0.08**	-0.0747*	-	-0.0502	-0.0935*	-0.107**	-	-0.0986*	-0.0928*
	(-2.07)		(-1.38)	(-2.19)	(-1.87)		(-1.31)	(-1.84)	(-2.05)		(-1.95)	(-1.83)
VOTES/SEATS	1.22***	-	0.7*	1.12**	1.133***	-	0.721**	8.322	16.66**	-	9.309	9.319
	(2.73)		(1.74)	(2.5)	(2.97)		(2.08)	(1.08)	(2.17)		(1.23)	(1.2()
CONSTANT	-	-	-	4.754	-22.22**	-21.91**	11.71***	45.23	124.3	-49.79	98.84	80.05
					(-2.03)	(-2.14)	(2.75)	(0.46)	(1.31)	(-1.27)	(1.22)	(0.97)
N	416	416	416	416	416	416	416	416	442	416	416	416

Note: t statistics in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01

4. Discussion and policy implications

Port investment is one of the most relevant issues in modern port economics related to planning port development, financing or assessing the return on investment (Musso et al., 2006).

However, few empirical studies in the academic literature have analyzed the determinants of port investment allocation. To the best of our knowledge, only Castillo-Manzano and Fageda (2014) study addresses this analysis in the Spanish context.

Our estimations show that a more disaggregated analysis of determinants for different port investment categories matters. First, some port-related variables, GDP per capita, or political-related variables are only significant when public port investment is disaggregated into different categories. We demonstrate this result by comparing our estimates with those from Castillo-Manzano and Fageda (2014), where public port investment is aggregated. Second, we find that determinants for different categories of public investment of port authorities differ. For instance, we demonstrate that specialization in containerized cargo is related to higher investment in infrastructure and capacity. However, those port authorities located in wealthier provinces present higher logistics and intermodal transport investment. Regarding political motivation, the coincidence between the incumbent political party in the central and local or regional governments is important to understand the different investment categories. Finally, we find higher public investment in those provinces where higher votes are needed to gain a seat. Additionally, the smaller the differences in votes between the two main parties in a given province, the higher the investment in the ports located there is, fulfilling the swing voter hypothesis.

Our research shows some practical policy implications. Although the EU transport policy focuses on selecting port investment projects based on their efficiency in social terms, we first demonstrate that political factors also play a relevant role in understanding port investment allocation in the Spanish context. In this sense, the 1997 reform of port decentralization might explain the importance of partisan alignment between local/regional governments and national government within the board of directors of Spanish port authorities to receive more investments than unaligned boards of directors. Second, the partisan alignment between local and national governments shows higher public port investment related to infrastructure and capacity. In contrast, partisan alignment between regional and national governments shows higher public port investment related to logistics and intermodal transport. Then, the role of Puertos del Estado as a coordinator for the allocation of port authorities' port investment is essential.

Future lines of research are related to analyzing the complementarity or substitutability between port infrastructure investment from public authorities and port superstructure investment from private port operators. Using this research framework, we could test whether a crowding out effect exists in the port industry or not.

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